PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing: 17 January 2002 (17.01.02)	
International application No.: PCT/US00/18705	Applicant's or agent's file reference: 302.05-PCT
International filing date: 07 July 2000 (07.07.00)	Priority date:
Applicant: ADDINK, John et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

18 January 2001 (18.01.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer:

J. Zahra

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
ROBERT D. FISH
FISH & ASSOCIATES, LLP
1440 N. HARBOR BLVD.
SUITE 706
FULLERTON, CA 92835

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing *(day/month/year)*	09-NOV 2001

Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
302.05-PCT	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US00/18705	07 July 2000 (07.07.2000)	NONE

Applicant

AQUA CONSERVATION SYSTEMS, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	William Grant
Facsimile No. (703)305-3230	Telephone No. (703) 305-9600

Form PCT/IPEA/416 (July 1992)

COPY

10/009867

PCT REQUEST

302.05-PCT

Original (for SUBMISSION) - printed on 07.07.2000 02:59:42 PM

0 0-1	For receiving Office use only International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4 0-4-1	Form - PCT/RO/101 PCT Request Prepared using	PCT-EASY Version 2.91 (updated 01.07.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	United States Patent and Trademark Office (USPTO) (RO/US)
0-7	Applicant's or agent's file reference	302.05-PCT
I	Title of invention	IRRIGATION CONTROLLER USING REGRESSION MODEL
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	AQUA CONSERVATION SYSTEMS, INC.
II-5	Address:	2900 Adams, Suite B6 Riverside, CA 92504 United States of America
II-6	State of nationality	US
II-7	State of residence	US
II-8	Telephone No.	909-780-8517
II-9	Facsimile No.	909-794-2129
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	ADDINK, John
III-1-5	Address:	AQUA CONSERVATION SYSTEMS, INC. 2900 Adams, Suite B6 Riverside, CA 92504 United States of America
III-1-6	State of nationality	US
III-1-7	State of residence	US

PCT REQUEST

302.05-PCT

Original (for SUBMISSION) - printed on 07.07.2000 02:59:42 PM

III-2	**Applicant and/or inventor**	
III-2-1	This person is:	applicant and inventor
III-2-2	Applicant for	US only
III-2-4	Name (LAST, First)	ADDINK, Sylvan
III-2-5	Address:	AQUA CONSERVATION SYSTEMS, INC. 2900 Adams, Suite B6 Riverside, CA 92504 United States of America
III-2-6	State of nationality	US
III-2-7	State of residence	US
IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	FISH, Robert
IV-1-2	Address:	FISH & ASSOCIATES, LLP 1440 N. Harbor Blvd. Suite 706 Fullerton, CA 92835 United States of America
IV-1-3	Telephone No.	714-449-2337
IV-1-4	Facsimile No.	714-449-2339
IV-1-5	e-mail	RFish@fishandassociates.com
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT

PCT REQUEST

302.05-PCT

Original (for **SUBMISSION**) - printed on 07.07.2000 02:59:42 PM

V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT (patent and utility model) AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ (patent and utility model) DE (patent and utility model) DK (patent and utility model) DM DZ EE (patent and utility model) ES FI (patent and utility model) GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK (patent and utility model) SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW	
V-3	National Patent (States which have become party to the PCT after the issuance of this version of EASY)	ALL OTHER STATES	
V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	**Exclusion(s) from precautionary designations**	NONE	
VI	**Priority claim**	NONE	
VII-1	**International Searching Authority Chosen**	United States Patent and Trademark Office (USPTO) (ISA/US)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	6	-
VIII-3	Claims	2	-
VIII-4	Abstract	1	abstract.txt
VIII-5	Drawings	7	-
VIII-7	TOTAL	20	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	reference no. 302.05-PCT	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	**Figure f the drawings which should accompany the abstract**	1	
VIII-19	**Language of filing of the international application**	English	

PCT REQUEST

302.05-PCT

Original (for **SUBMISSION**) - printed on 07.07.2000 02:59:42 PM

IX-1	Signature of applicant or agent	
IX-1-1	Name (LAST, First)	FISH, Robert

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/US
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	

PCT (ANNEX - FEE CALCULATION SHEET)

302.05-PCT

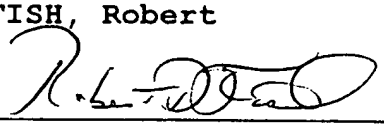
Original (for SUBMISSION) - printed on 07.07.2000 02:59:42 PM

(This sheet is not part of and does not count as a sheet of the international application)

0 0-1	For receiving Office use only International Application No.			
0-2	Date stamp of the receiving Office			
0-4 0-4-1	Form - PCT/RO/101 (Annex) PCT Fee Calculation Sheet Prepared using	PCT-EASY Version 2.91 (updated 01.07.2000)		
0-9	Applicant's or agent's file reference	302.05-PCT		
2	Applicant	AQUA CONSERVATION SYSTEMS, INC., et al.		
12	Calculation of prescribed fees	fee amount/multiplier	total amounts (USD)	
12-1	Transmittal fee T	⇨	240	
12-2	Search fee S	⇨	700	
12-3	International fee Basic fee (first 30 sheets) b1	427		
12-4	Remaining sheets	0		
12-5	Additional amount (X)	10		
12-6	Total additional amount b2	0		
12-7	b1 + b2 = B	427		
12-8	Designation fees Number of designations contained in international application	88		
12-9	Number of designation fees payable (maximum 8)	8		
12-10	Amount of designation fee (X)	92		
12-11	Total designation fees D	736		
12-12	PCT-EASY fee reduction R	-132		
12-13	Total International fee (B+D-R) I	⇨	1,031	
12-17	TOTAL FEES PAYABLE (T+S+I+P)	⇨	1,971	
12-19	Mode of payment	authorization to charge deposit account		
12-20	Deposit account instructions The receiving Office:	United States Patent and Trademark Office (USPTO) (RO/US)		
12-20-1	is hereby authorized to charge the total fees indicated above to my deposit account	✓ Robert J. Seel		
12-20-2	is hereby authorized to charge any deficiency or credit any over-payment in the total fees indicated above to my deposit account	✓ Robert J. Seel		
12-21	Deposit account No.	500341		
12-22	Date	07 July 2000 (07.07.2000)		

PCT (ANNEX - FEE CALCULATION SHEET) 302.05-PCT

Original (for SUBMISSION) - printed on 07.07.2000 02:59:42 PM

12-23	Name and signature	FISH, Robert 

VALIDATION LOG AND REMARKS

13-2-2	Validation messages States	Yellow! Additional national designation added: Obtain updated maintenance tables rather than using this field.
13-2-4	Validation messages Priority	Green? No priority of an earlier application has been claimed. Please verify
13-2-7	Validation messages Fees	Green? Please confirm that fee schedule utilized is the latest available
13-2-8	Validation messages Payment	Green? Please ensure that you have a valid deposit account with the receiving Office selected.

Practitioner's Docket No. **302.05 PCT**

IN THE INTERNATIONAL BUREAU (WIPO)

International Application Number	International Filing Date	International Earliest Priority Date
PCT/US00/18705	7 July 2000	7 July 2000

Title of Invention: **Irrigation Controller Using Regression Model**
Applicant: **Aqua Conservation Systems, Inc.**

International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20
Switzerland

LETTER FOR PCT ARTICLE 19 (PCT SECTION 205)

1. Applicant herewith submits replacement sheets(s) number(ed) **7-8** to replace sheet(s) number(ed) **7-8** originally filed for this application.

2. In respect of each claim appearing in the international application based on the replacement sheets submitted herewith, and in accordance with PCT Section 205, the following claim(s) is/are:

(i) unchanged: claim(s) **2-15**
(ii) cancelled: claim(s) **0**
(iii) new: claim(s) **0**
(iv) replacement of one or more claims as filed, as follows: **1**
(v) the result of the division of one or more claims as filed, as follows: **0**

Dear Sir:

The Search Report dated 27 December 2000 designated three references as being relevant to patentability. In response, Claim 1 has been revised. The revised claim and references are addressed below seriatim.

Revised Claims

1. An irrigation controller comprising:

a memory that stores a regression model;

a microprocessor that applies a value for an environmental factor to the regression model to estimate an evapotranspiration rate (estimated ET_o); and

a mechanism that uses the estimated ET_o to affect an irrigation schedule executed by the controller.

Marian (US Patent 5208855)

The Office considers claims 1-15 to be obvious over Marian. The applicant disagrees, especially in view of the amendments herein. Marian fails to teach, suggest, or motivate one of ordinary skill in the field to arrive at the claimed subject matter.

Claims 1-15 of the present application recite:

- "a memory that stores a **regression model**";
- "a microprocessor that applies a value for an environmental factor to the **regression model** to estimate an evapotranspiration rate (ET_o)"; and
- "a mechanism that uses the ... ET_o[, estimated from the **regression model**] to affect an irrigation schedule."

Thus, at least three different limitations are recited, all relating to a regression model.

Marian teaches a receiver-controller that receives broadcast ET_o values once a week, calculates a scaled ET_o value by multiplying an already programmed crop coefficient (K_c) by the broadcast ET_o value to obtain a watering amount, and applies that amount of water.

Marian does not satisfy any of the limitations identified above. First, Marian does not teach, suggest, or motivate one skilled in the art to provide a memory that stores a **regression model**. Second, Marian does not teach, suggest, or motivate one skilled in the art to **use the regression model to estimate an ETo rate**. Third, Marian does not teach, suggest, or motivate one skilled in the art to **use that estimated ETo rate obtained from regression analysis to affect an irrigation schedule**.

The distinctions discussed above make an enormous difference. If the weather increases abruptly from Monday to Tuesday, embodiments of the present claims would be able to adjust the irrigation schedule to the sudden increase in temperature. The higher temperature would be detected by a sensor and fed into a regression model to estimate a correspondingly higher ET_o, which would result in more water being applied.

On the other hand, if weekly ET_o values were broadcast on Sundays, Marian would not be able to adjust the irrigation schedule to any sudden weather change occurring on Tuesday. In Marian, the controller-receiver receives the ET_o data **once a week**, calculates a scaled ET_o value, and uses the scaled ET_o values to determine how much water to apply. Yes, Marian probably contemplates broadcasts at intervals other than once a week, but regardless of the interval, the analysis is the same. Any change occurring between broadcasts is not taken into account.

Morgenstern et al. (US Patent 5839660)

The Office considers claims 1-15 to be obvious over Morgenstern et al. The applicant disagrees, especially in view of the amendments herein. Morgenstern et al. fails to teach, suggest, or motivate one of ordinary skill in the field to arrive at the claimed subject matter.

As noted above, claims 1-15 of the present application recite: "a memory that stores a regression model, a microprocessor that applies a value for an environmental factor to the regression model to estimate an evapotranspiration rate (ET_o), and a mechanism that uses the ... ET_o to affect an irrigation schedule." Thus, three different limitations are recited.

Morgenstern et al. teaches a microprocessor programmed to add a fixed amount of water per day (such as one-fourth inch) except where one of three thresholds is breached: (1) when amount of water actually applied over a time period exceeds a threshold; (2) when the temperature falls below a threshold amount (thirty-six degrees Fahrenheit); or (3) when the wind velocity exceeds a threshold amount (ten miles per hour).

Morgenstern et al. does not satisfy any of the limitations identified above. Morgenstern et al. does not teach, suggest, or motivate one skilled in the art (a) to provide a memory that stores a **regression model**, (b) to **use the regression model to estimate an ETo rate**; and (c) **to use that estimated ETo rate obtained from regression analysis to affect an irrigation schedule**.

Once again, the distinctions discussed above make an enormous difference. To use another example, if there is an abnormal temperature on a particular day in October, embodiments of the present invention would be able to affect the irrigation schedule by estimating an ET_o value from a temperature reading, using regression analysis. According to the regression model, if temperature increases, then the estimated ET_o value would also increase, and if temperature decreases, the estimated ET_o value would also decrease.

In Morgenstern et al., on the other hand, a microprocessor first checks a water level sensor to determine whether a water level threshold is breached, and if so, would interrupt the watering schedule. Second, the microprocessor would check the temperature sensor to determine if it is below the threshold temperature, and if so, would interrupt the watering schedule. Third, the microprocessor would check the wind velocity sensor to determine it is above the current threshold, and if so, would interrupt the watering schedule. If interruption in the watering schedule does not occur, then the sprinklers would deliver the predetermined amount of water (e.g. one-fourth inch). Morgenstern et al. **never uses a regression model** to affect the watering schedule, as presently claimed.

Oliver (US Patent 5696671)

The Office considers claims 1-15 to be obvious over Oliver. The applicant disagrees, especially in view of the amendments herein. As noted above, claims 1-15 of the present application all recite limitations relating to regression analysis, and Oliver fails to teach, suggest, or motivate one of ordinary skill in the field to utilize regression analysis in any manner whatsoever.

Oliver teaches a computer that **calculates** a forecasted ET_o based on forecasted weather, and then controls the irrigation schedule according to that forecasted ET_o value. Oliver does not satisfy any of the limitations set forth above. As with all of the other cited references, Oliver fails to teach, suggest, or motivate one skilled in the art to (a) provide a memory that stores a **regression model**; (b) **use the regression model to estimate an ETo rate**; and (c) **use that estimated ETo rate obtained from regression analysis to affect an irrigation schedule**.

For the hypothetical temperature change in October discussed above, Oliver would presumably check the weather forecast and determine that the temperature would be high in the coming days. Oliver would then use that information to **calculate** a forecasted ET_o. In

this instance, Oliver would likely produce a watering schedule that is appropriate. But that would have nothing to do with the current claims, **which use regression analysis to estimate** ET_o from environmental factors such as temperature, using a regression model. **Oliver never uses a regression model to calculate ETo**, as presently claimed.

Conclusion

All pending claims require estimating ET_o using regression analysis. Yet none of the cited references deemed to preclude patentability have anything at all to do with regression analysis. Thus, either the cited references individually or in any combination teach, suggest, or motivate one of ordinary skill in the art to arrive at the pending claims.

Respectfully submitted,

Robert D. Fish, Esq.

Fish & Associates, LLP
1440 N. Harbor Blvd., Suite 706
Fullerton, CA 92835 USA
Tel: 714-449-2337
Fax: 714-449-2339

10/009867

PATENT COOPERATION TREATY

PCT

REC'D 14 NOV 2001
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

12

Applicant's or agent's file reference 302.05-PCT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US00/18705	International filing date *(day/month/year)* 07 July 2000 (07.07.2000)	Priority date *(day/month/year)* NONE

International Patent Classification (IPC) or national classification and IPC

IPC(7): G05D 7/06; A01G 25/16 and US Cl.: 700/284; 239/69

Applicant

AQUA CONSERVATION SYSTEMS, INC.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☑ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 7 sheets.

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3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
18 January 2001 (18.01.2001)	06 September 2001 (06.09.2001)
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer William Grant Telephone No. (703) 305-9600

Form PCT/IPEA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

Int[redacted]ional application No.
PCT/US00/18705

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed.

☒ the description:
pages 1-3 as originally filed
pages NONE, filed with the demand
pages 4-6, filed with the letter of 23 May 2001 (23.05.2001).

☒ the claims:
pages NONE, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages 7-8, filed with the letter of 23 May 2001 (23.05.2001).

☒ the drawings:
pages 2, 4-7, as originally filed
pages NONE, filed with the demand
pages 1, 3, filed with the letter of 23 May 2001 (23.05.2001).

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

☒ the description, pages NONE

☒ the claims, Nos. NONE

☒ the drawings, sheets/~~fig~~ NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*
*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US00/18705

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Claims	NONE	YES
	Claims	1-15	NO
Inventive Step (IS)	Claims	NONE	YES
	Claims	1-15	NO
Industrial Applicability (IA)	Claims	1-15	YES
	Claims	NONE	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-15 lack novelty under PCT Article 33(2) as being anticipated by Oliver (U.S. Pat 5,696,671). Oliver teaches an irrigation controller (reference number 4, col. 7 lines 55-60), comprising: a memory (col. 7 line 66 - col. 8 line 8) that stores a regression model (col. 5 line 45-60, meteorological model), a microprocessor (part of reference number 4) that applies a value for an environmental factor to the regression model (col. 5 line 61 - col. 6 line 15) to estimate a current evapotranspiration rate (estimated ETo) (col. 5 line 45 - col. 6 line 37, host computer uses model to determine a predicted ETo value, col. 5 lines 50-54 prediction of future meteorological conditions on an hourly basis places the prediction in the current day and therefore current ETo, col. 6 lines 10-15 an estimated current ETo as compared to the actual which places the predicted values in the present or current time reference therefore this teaches "to estimate a current evapotranspiration rate"), a mechanism that uses the estimated ETo to affect an irrigation schedule executed by the controller (col. 8 lines 39-48), wherein the regression model is based upon a set of historical ETo values and a set of corresponding historical values for the environmental factor (col. 5 lines 45-60, col. 7 lines 24-39, environmental factor as defined on page 3 lines 3-4), wherein the set of historical ETo values spans a time period of at least two days (col. 7 lines 24-39), wherein the regression model is further based upon a second set of historical values for a second environmental factor (col. 5 lines 7-26), wherein the regression model comprises a linear regression (col. 5 lines 47-50), wherein the regression model comprises a multiple regression (col. 5 lines 50-57), wherein the environmental factor is temperature (col. 5 line 55), wherein the environmental factor is solar radiation (col. 5 line 56), wherein the environmental factor is wind speed (col. 5 line 56), wherein the environmental factor is humidity (col. 5 line 55), wherein the environmental factor is barometric pressure (col. 5 lines 55-56), wherein the environmental factor is soil moisture (col. 6 lines 55-57), wherein the environmental factor is selected from the group consisting of temperature, solar radiation, wind speed, humidity, barometric pressure, and soil moisture (col. 5 lines 54-57, col. 8 lines 49-61), a local sensor that provides a signal corresponding to the value for the environmental factor (col. 6 lines 55-67), and a receiver that receives from a distal source a signal corresponding to the value for the environmental factor (col. 8 lines 9-30).

---------- NEW CITATIONS ----------

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The description is objected to as containing the following defect(s) under PCT Rule 66.2(a)(iii) in the form or contents thereof:
Page 5 line 21 refers to "providingan irrigation controller", should be "providing irrigation controller".

regression for the historical ETo values and the historical environmental values 30; determining a regression model 40; obtaining a current local value for an environmental factor 50; applying that value to the regression model 40 to estimate current ETo 60; using the current ETo to determine the watering schedule 70; and then executing the watering schedule 80.

The historical ETo values may be obtained from a number of sources, including government managed weather stations such as CIMIS (California Irrigation Management Information System, maintained by the California Department of Water Resources), CoAgMet maintained by Colorado State University-Atmospheric Sciences, AZMET maintained by University of Arizona-Soils, Water and Environmental Science Department, New Mexico State University-Agronomy and Horticulture, and Texas A&M University-Agricultural Engineering Department. Although slight variations in the methods used to determine the ETo values do exist, most ETo calculations utilize the following environmental factors: temperature, solar radiation, wind speed, vapor pressure or humidity, and barometric pressure.

Figure 2 shows an exemplary relationship of temperature versus ETo over a month. An increase in temperature generally results in an increase in the ETo value, with the opposite occurring upon a decrease in temperature. The other factors have greater or lesser effects than temperature on ETo, but all have some effect on ETo, and each of the environmental factors can be used in the determination of a regression model.

Regression analysis can be performed on any suitable time period. Several years of data is preferred, but shorter time spans such as several months, or even a single month, can also be used. Different regression models can also be generated for different seasons during the year, for different geographic zones, and so forth.

The regression model is preferably programmed into the central processing unit or memory of the irrigation controller using a suitable assembler language or microcode (See Figure 5, 210 and 220). The value or values applied against the regression model are preferably obtained from one or more local sensors (see Figure 6, steps 311 through 316). The microprocessor based central processing unit may have conventional interface hardware for receiving and interpreting of data or signals such sensors.

In **Figure 3** the initial step in a preferred determination of a regression model is to select zones with similar evapotranspiration characteristics, step 100. A representative weather station, which provides ETo values, is selected in the zone, step 110. Preferably, monthly linear regression is performed of one or more historical factor(s) against the historical ETo values, step 120. Monthly regression models are determined from these regression relationships, step 130. All irrigation controllers located in a specific zone are then programmed with the regression models determined for that zone, step 140.

Figure 4 is a map depicting how California might be divided into zones with similar evapotranspiration characteristics, and the location of a representative weather station within each zone.

Figure 5 is a schematic of an irrigation controller programmed with a regression model that, along with other inputs and/or adjustments, would determine the run times for the various stations controlled by the irrigation controller. A preferred embodiment of an irrigation controller 200 generally includes a microprocessor based central processing unit 210, an on-board memory 220, some manual input devices 230 through 234 (buttons and or knobs), a signal receiving device 240, a display screen 250, a plurality of electrical connectors 260 for connecting with solenoids 270, and a power supply 280. Each of these components by itself is well known in the electronic industry, with the exception of the programming of the microprocessor in accordance with the functionality set forth herein.

Figure 6 is a flow chart of an irrigation system according to the present invention. It starts with step 300 of providingan irrigation controller (See Figure 5, 200) with a regression model programmed in the microprocessor based central processing unit 200. Step 310 is the receiving of measurements of one or more current environmental factor(s). These measurements are applied to the regression model 320 and the run times are determined by the regression model 330. However, the controller may not activate the valves to irrigate the landscape until an adequate irrigation run time has accumulated to permit for deep watering of the soil (not shown). When an adequate irrigation run time has been accumulated the controller will activate the valves to each station and the landscape will be irrigated 340, except when a manual or automatic override of irrigation occurs.

Figure 7 is a comparison between actual ETo values and ETo values determined according to the present invention for 1999 data from a weather station located at Merced, California. As the figure indicates, some differences do exist between actual ETo values and ETo values determined by the present invention. However, landscapes at Merced, California, receiving irrigation based on the present invention, would receive close to the right amount of water required to maintain the plants in a healthy condition and with a reduced waste of water.

Controllers contemplated herein may, of course, advantageously include features that are not necessarily related to the provisioning or use of optionally sequential/concurrent stations. Among other things, contemplated controllers may employ software that obtains an evapotranspiration rate (ETo) from a distal source as described in pending US application serial number 09/082603. Contemplated controllers may also employ software that modifies watering patterns based upon a water budget or sensor input as described in pending US application serial numbers 09/478108 and 60/209709, respectively. Contemplated controllers may also employ a simplified adjustment mechanism such as a "more/less" button as described in pending US application serial number 09/603104. The disclosures of each of these applications are incorporated herein by reference in their entirety.

Thus, specific embodiments and applications of irrigation controllers using regression models have been disclosed. It should be apparent, however, to those skilled in the art that many more modifications besides those described are possible without departing from the inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the spirit of the appended claims.

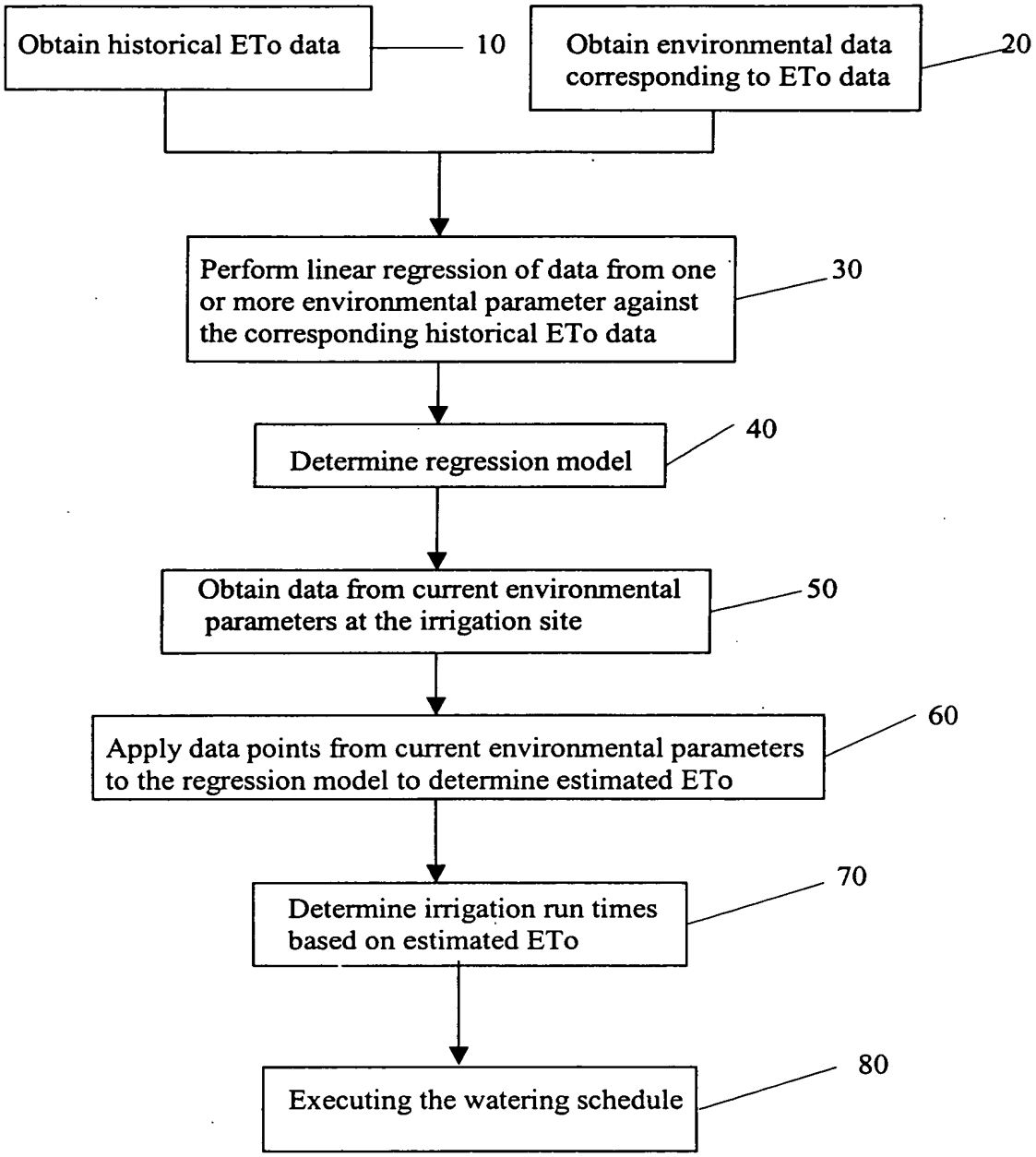

Figure 1

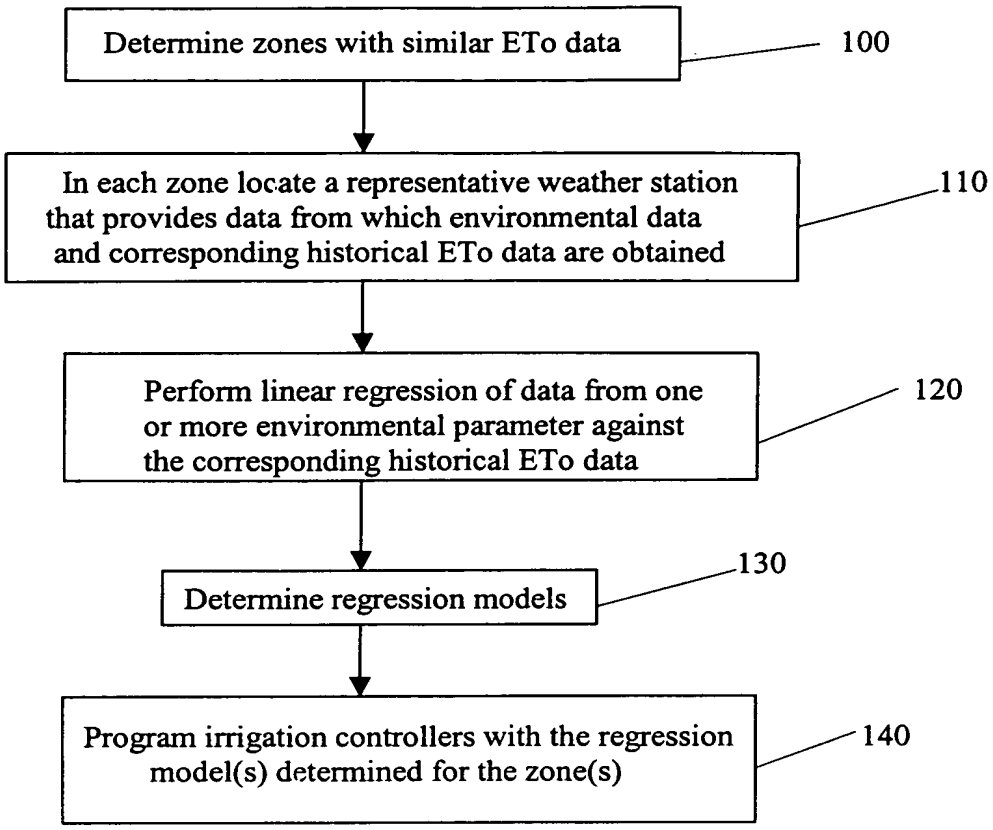
Determine zones with similar ETo data
100
In each zone locate a representative weather station that provides data from which environmental data and corresponding historical ETo data are obtained
110
Perform linear regression of data from one or more environmental parameter against the corresponding historical ETo data
120
Determine regression models
130
Program irrigation controllers with the regression model(s) determined for the zone(s)
140

Figure 3

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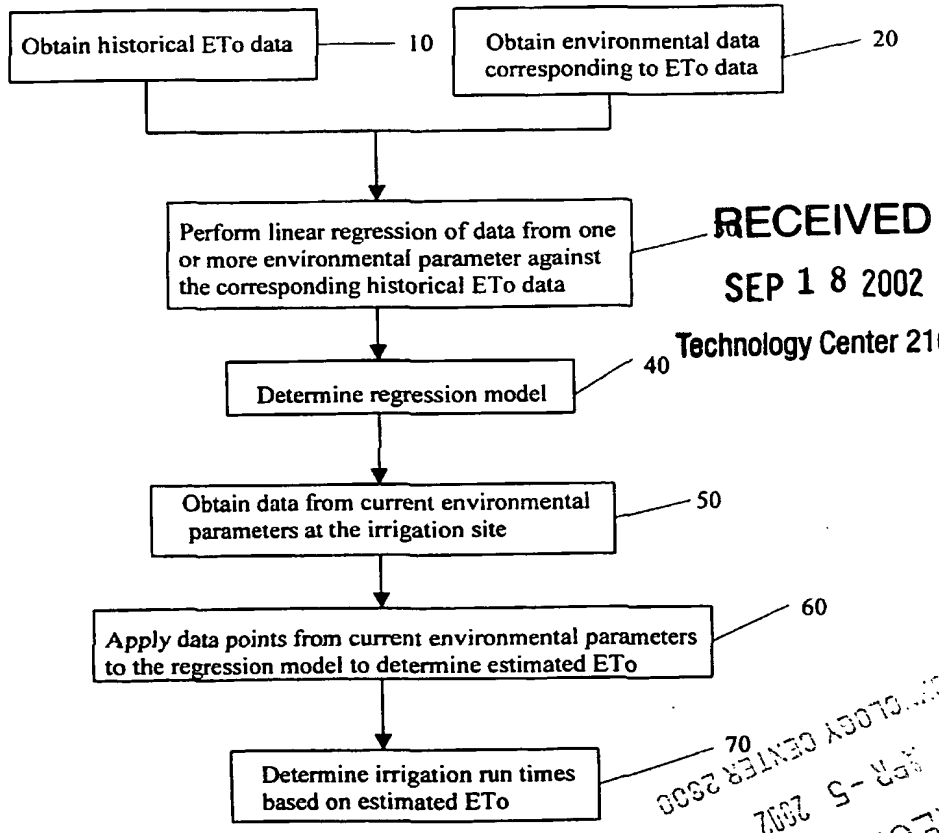
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: IRRIGATION CONTROLLER USING REGRESSION MODEL



(57) Abstract: The present invention provides systems and methods in which an irrigation controller (200) uses a regression model (40) to estimate an evapotranspiration rate (estimated ETo), and uses the estimated ETo (60) to affect an irrigation schedule (70) executed by the controller. The regression model (40) is preferably based upon a comparison of historical ETo values (10) against corresponding historical environmental values (20), with the data advantageously spanning a time period of at least one month, and more preferably at least two months. Data for multiple environmental factors may also be used. The environmental factor(s) utilized may advantageously comprise one or more of temperature (311), solar radiation (312), wind speed (313), humidity (314), barometric pressure (315), and soil moisture (316). Values relating the environmental factor(s) may enter the controller from a local sensor, a distal signal source, or both.

WO 02/05045 A1

Published:
— *with international search report*
— *with amended claims*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

IRRIGATION CONTROLLER USING REGRESSION MODEL

Field of the Invention

The field of the invention is irrigation controllers.

Background of the Invention

Many irrigation controllers have been developed for automatically controlling application of water to landscapes. Known irrigation controllers range from simple devices that control watering times based upon fixed schedules, to sophisticated devices that vary the watering schedules according to local geography and climatic conditions.

With respect to the simpler types of irrigation controllers, a homeowner typically sets a watering schedule that involves specific run times and days for each of a plurality of stations, and the controller executes the same schedule regardless of the season or weather conditions. From time to time the homeowner may manually adjust the watering schedule, but such adjustments are usually only made a few times during the year, and are based upon the homeowner's perceptions rather than the actual watering needs. One change is often made in the late Spring when a portion of the yard becomes brown due to a lack of water. Another change is often made in the late Fall when the homeowner assumes that the vegetation does not require as much watering. These changes to the watering schedule are typically insufficient to achieve efficient watering.

More sophisticated irrigation controllers usually include some mechanism for automatically making adjustments to the irrigation run times to account for daily environmental variations. One common adjustment is based on soil moisture. It is common, for example, to place sensors locally in the soil, and suspend irrigation as long as the sensor detects moisture above a given threshold. Controllers of this type help to reduce over irrigating, but placement of the sensors is critical to successful operation.

Still more sophisticated irrigation controllers use evapotranspiration rates for determining the amount of water to be applied to a landscape. Evapotranspiration is the water lost by direct evaporation from the soil and plant and by transpiration from the plant surface. Potential (i.e, estimated) evapotranspiration (ETo) can be calculated from meteorological data collected on-site, or

from a similar site. ETo data from meteorological monitoring equipment located on the irrigation site is thought to provide the most efficient irrigating of the landscape, however, monitoring equipment required to obtain the ETo values is very expensive to install and operate. Therefore, most of the data for ETo calculations is gathered from off-site locations that are frequently operated by government agencies. The ETo data is then broadcast by various methods to the irrigation sites. One such system, disclosed in US Patent No. 4,962,522, issued October 1990, and in US Patent No. 5,208,855, issued May 1993, both to Marian, transmits ETo values for multiple geographic zones. Irrigation controllers receive and extract appropriate data for the local conditions, and then use the extracted data to calculate run times. Unfortunately, known controllers of this type are notoriously complicated to use, and even systems touting automatic adjustment of irrigation flow still require relatively complicated input. Systems discussed in the 5,208,855 patent, for example, receive the signal, and update the interval used for preset irrigation control timings rather than determine an entirely new irrigation schedule. Systems discussed in US Patent No. 5,444,611 issued August, 1995 to Woytowitz et al., automatically calculate and execute a new schedule, but the new schedule is based upon meteorological data that may not be applicable to the local conditions.

Thus, because of cost and/or complicated operating requirements, most residential and small commercial landscape sites are primarily irrigated by controllers that provide inadequate schedule modification. This results in either too much or too little water being applied to the landscape, which in turn results in both inefficient use of water and unnecessary stress to the plants. Therefore, a need still exists for a cost-effective irrigation system for residential and small commercial landscape sites, which is capable of frequently varying the irrigation schedule based upon estimates of actual water requirements.

Summary of the Invention

The present invention provides systems and methods in which an irrigation controller uses a regression model to estimate an evapotranspiration rate (estimated ETo), and uses the estimated ETo to affect an irrigation schedule executed by the controller.

The regression model is preferably based upon a comparison of historical ETo values against corresponding historical environmental values, with the data advantageously spanning a

time period of at least two days, and more preferably at least one month. Data from multiple environmental factors may also be used.

The environmental factor(s) utilized may advantageously comprise one or more of temperature, solar radiation, wind speed, humidity, barometric pressure, and soil moisture. Values relating the environmental factor(s) may enter the controller from a local sensor, a distal signal source, or both.

Various objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the invention, along with the accompanying drawings in which like numerals represent like components.

Brief Description of the Drawings

Figure 1 is a flow chart of a preferred embodiment of the method of the present invention.

Figure 2 is a figure showing an exemplary relationship of ETo versus temperature.

Figure 3 is a flow chart of the steps in the determination of a regression model which would be programmed in irrigation controllers.

Figure 4 is a map depicting how California might be divided into zones with similar evapotranspiration characteristics, and the location of a representative weather station within each zone.

Figure 5 is a schematic of an irrigation controller.

Figure 6 is a flow chart of an irrigation system according to the present invention.

Figure 7 is a figure showing an exemplary comparison between ETo values determined according to the present invention and actual ETo values for 1999 from a weather station located at Merced, California.

Detailed Description

In **Figure 1** a method of controlling irrigation run time generally comprises: providing historical ETo values 10; providing corresponding environmental values 20; performing a linear

regression for the historical ETo values and the historical environmental values 30; determining a regression model 40; obtaining a current local value for an environmental factor 50; applying that value to the regression model 60 to estimate current ETo 60; using the current ETo to determine the watering schedule 70; and then executing the watering schedule 80.

The historical ETo values may be obtained from a number of sources, including government managed weather stations such as CIMIS (California Irrigation Management Information System, maintained by the California Department of Water Resources), CoAgMet maintained by Colorado State University-Atmospheric Sciences, AZMET maintained by University of Arizona-Soils, Water and Environmental Science Department, New Mexico State University-Agronomy and Horticulture, and Texas A&M University-Agricultural Engineering Department. Although slight variations in the methods used to determine the ETo values do exist, most ETo calculations utilize the following environmental factors: temperature, solar radiation, wind speed, vapor pressure or humidity, and barometric pressure.

Figure 2 shows an exemplary relationship of temperature versus ETo over a month. An increase in temperature generally results in an increase in the ETo value, with the opposite occurring upon a decrease in temperature. The other factors have greater or lesser effects than temperature on ETo, but all have some effect on ETo, and each of the environmental factors can be used in the determination of a regression model.

Regression analysis can be performed on any suitable time period. Several years of data is preferred, but shorter time spans such as several months, or even a single month, can also be used. Different regression models can also be generated for different seasons during the year, for different geographic zones, and so forth.

The regression model is preferably programmed into the central processing unit or memory of the irrigation controller using a suitable assembler language or microcode (See Figure 5, 210 and 220). The value or values applied against the regression model are preferably obtained from one or more local sensors (see Figure 6, steps 311 through 316). The microprocessor based central processing unit may have conventional interface hardware for receiving and interpreting of data or signals such sensors.

In **Figure 3** the initial step in a preferred determination of a regression model is to select zones with similar evapotranspiration characteristics, step 100. A representative weather station, which provides ETo values, is selected in the zone, step 110. Preferably, monthly linear regression is performed of one or more historical factor(s) against the historical ETo values, step 120. Monthly regression models are determined from these regression relationships, step 130. All irrigation controllers located in a specific zone are then programmed with the regression models determined for that zone, step 140.

Figure 4 is a map depicting how California might be divided into zones with similar evapotranspiration characteristics, and the location of a representative weather station within each zone.

Figure 5 is a schematic of an irrigation controller programmed with a regression model that, along with other inputs and/or adjustments, would determine the run times for the various stations controlled by the irrigation controller. A preferred embodiment of an irrigation controller 200 generally includes a microprocessor based central processing unit 210, an on-board memory 220, some manual input devices 230 through 234 (buttons and or knobs), a signal receiving device 240, a display screen 250, a plurality of electrical connectors 260 for connecting with solenoids 270, and a power supply 280. Each of these components by itself is well known in the electronic industry, with the exception of the programming of the microprocessor in accordance with the functionality set forth herein.

Figure 6 is a flow chart of an irrigation system according to the present invention. It starts with the controller 300 such as that described in the immediately preceding paragraph. Step 310 is the receiving of measurements of one or more current environmental factor(s). These measurements are applied to the regression model and the run times are determined by the regression model 320. However, the controller may not activate the valves to irrigate the landscape until an adequate irrigation run time has accumulated to permit for the deep watering of the soil 330. When an adequate irrigation run time has been accumulated the controller will activate the valves to each station and the landscape will be irrigated, except when a manual or automatic override of irrigation occurs, steps 340 through 360.

Figure 7 is a comparison between actual ETo values and ETo values determined according to the present invention for 1999 data from a weather station located at Merced, California. As the figure indicates, some differences do exist between actual ETo values and ETo values determined by the present invention. However, landscapes at Merced, California, receiving irrigation based on the present invention, would receive close to the right amount of water required to maintain the plants in a healthy condition and with a reduced waste of water.

Controllers contemplated herein may, of course, advantageously include features that are not necessarily related to the provisioning or use of optionally sequential/concurrent stations. Among other things, contemplated controllers may employ software that obtains an evapotranspiration rate (ETo) from a distal source as described in pending US application serial number 09/082603, or estimates ETo using one or more environmental parameters as described in concurrently filed PCT application serial number _____, entitled "Irrigation Controller Using Regression Model". Contemplated controllers may also employ software that modifies watering patterns based upon a water budget or sensor input as described in pending US application serial numbers 09/478108 and 60/209709, respectively. Contemplated controllers may also employ a simplified adjustment mechanism such as a "more/less" button as described in pending US application serial number 09/603104. The disclosures of each of these applications are incorporated herein by reference in their entirety.

Thus, specific embodiments and applications of irrigation controllers using regression models have been disclosed. It should be apparent, however, to those skilled in the art that many more modifications besides those described are possible without departing from the inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the spirit of the appended claims.

Claims

What is claimed is:

1. An irrigation controller comprising:
   a memory that stores a regression model;
   a microprocessor that applies a value for an environmental factor to the regression model to estimate an evapotranspiration rate (estimated ETo);
   a mechanism that uses the estimated ETo to affect an irrigation schedule executed by the controller.

2. The controller of claim 1 wherein the regression model is based upon a set of historical ETo values and a set of corresponding historical values for the environmental factor.

3. The controller of claim 1 wherein the set of historical ETo values spans a time period of at least two days.

4. The controller of claim 2 wherein the regression model is further based upon a second set of historical values for a second environmental factor.

5. The controller of claim 2 wherein the regression model comprises a linear regression.

6. The controller of claim 2 wherein the regression model comprises a multiple regression.

7. The controller of claim 1 wherein the environmental factor is temperature.

8. The controller of claim 1 wherein the environmental factor is solar radiation.

9. The controller of claim 1 wherein the environmental factor is wind speed.

10. The controller of claim 1 wherein the environmental factor is humidity.

11. The controller of claim 1 wherein the environmental factor is barometric pressure.

12. The controller of claim 1 wherein the environmental factor is soil moisture.

13. The controller of claim 2 wherein the environmental factor is selected from the group consisting of temperature, solar radiation, wind speed, humidity, barometric pressure, and soil moisture.

14. An irrigation system comprising an irrigation controller according to claim 1, and a local sensor that provides a signal corresponding to the value for the environmental factor.

15. An irrigation system comprising an irrigation controller according to claim 1, and a receiver that receives from a distal source a signal corresponding to the value for the environmental factor.

AMENDED CLAIMS

[received by the International Bureau on 18 January 2001 (18.01.01);
original claim 1 amended; remaining claims unchanged (1 page)]

1. An irrigation controller comprising:
a memory that stores a regression model;
a microprocessor that applies a value for an environmental factor to the regression model to estimate an evapotranspiration rate (estimated ETo); and
a mechanism that uses the estimated ETo to affect an irrigation schedule executed by the controller.

2. The controller of claim 1 wherein the regression model is based upon a set of historical ETo values and a set of corresponding historical values for the environmental factor.

3. The controller of claim 1 wherein the set of historical ETo values spans a time period of at least two days.

4. The controller of claim 2 wherein the regression model is further based upon a second set of historical values for a second environmental factor.

5. The controller of claim 2 wherein the regression model comprises a linear regression.

6. The controller of claim 2 wherein the regression model comprises a multiple regression.

7. The controller of claim 1 wherein the environmental factor is temperature.

8. The controller of claim 1 wherein the environmental factor is solar radiation.

9. The controller of claim 1 wherein the environmental factor is wind speed.

10. The controller of claim 1 wherein the environmental factor is humidity.

11. The controller of claim 1 wherein the environmental factor is barometric pressure.

12. The controller of claim 1 wherein the environmental factor is soil moisture.

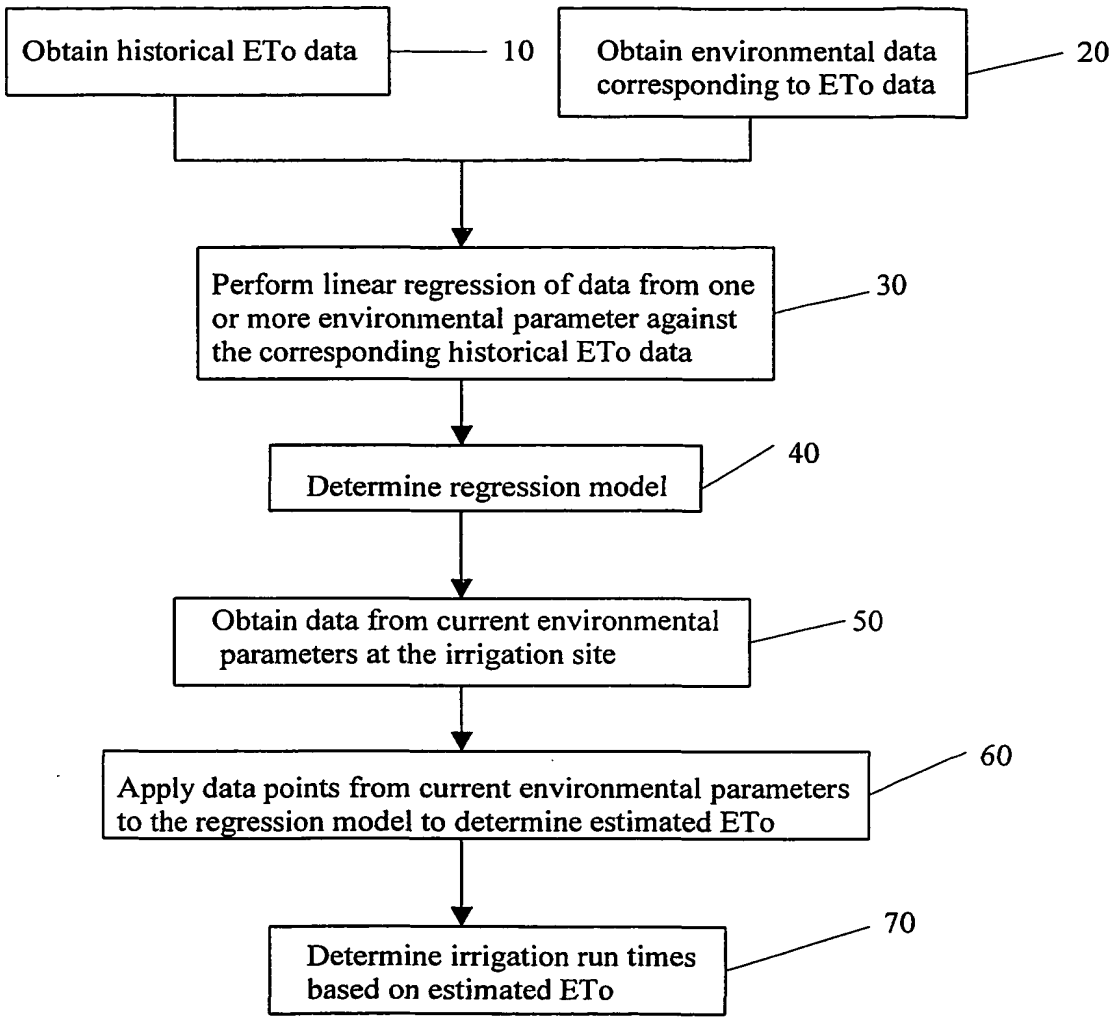

Obtain historical ETo data
10
Obtain environmental data corresponding to ETo data
20
Perform linear regression of data from one or more environmental parameter against the corresponding historical ETo data
30
Determine regression model
40
Obtain data from current environmental parameters at the irrigation site
50
Apply data points from current environmental parameters to the regression model to determine estimated ETo
60
Determine irrigation run times based on estimated ETo
70

Figure 1

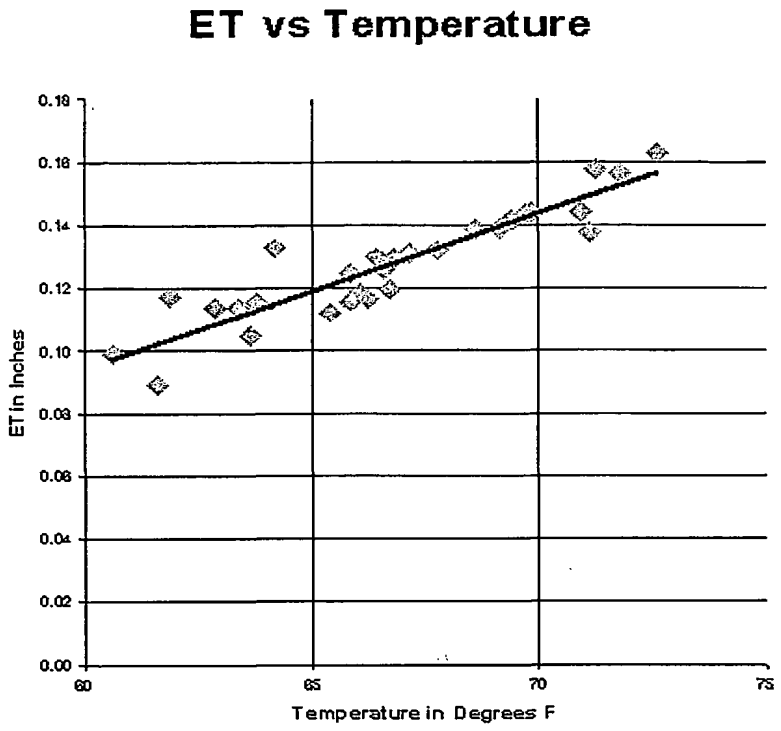

ET vs Temperature
ET In Inches
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
60
65
70
75
Temperature in Degrees F

Figure 2

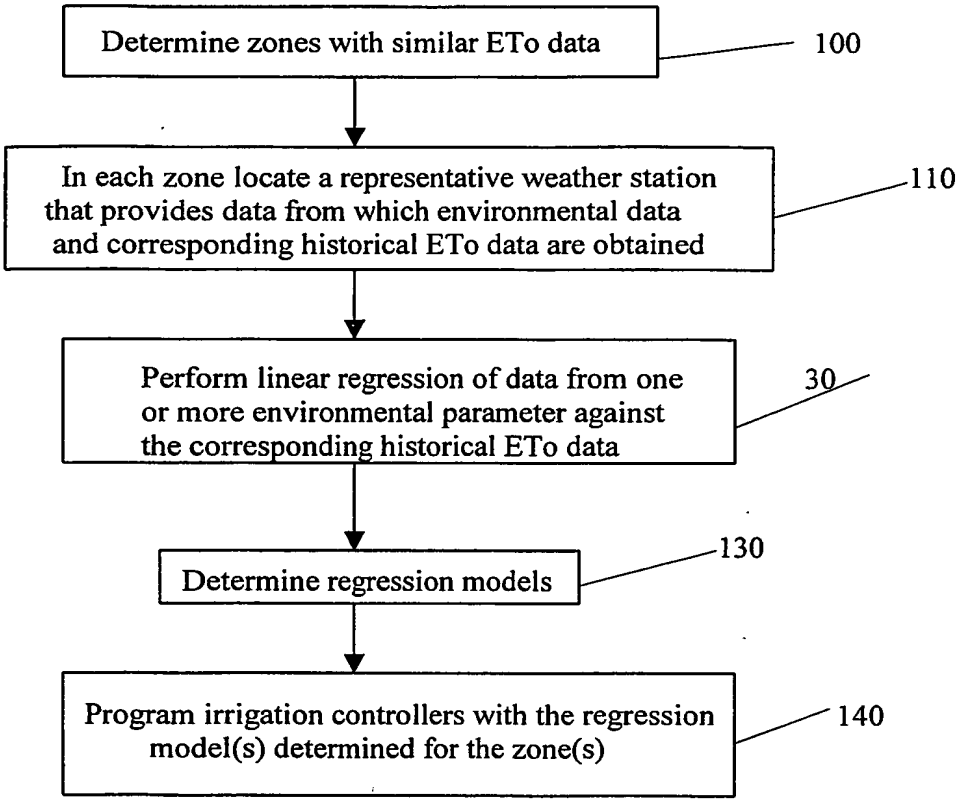

Determine zones with similar ETo data
100
In each zone locate a representative weather station that provides data from which environmental data and corresponding historical ETo data are obtained
110
Perform linear regression of data from one or more environmental parameter against the corresponding historical ETo data
30
Determine regression models
130
Program irrigation controllers with the regression model(s) determined for the zone(s)
140

Figure 3

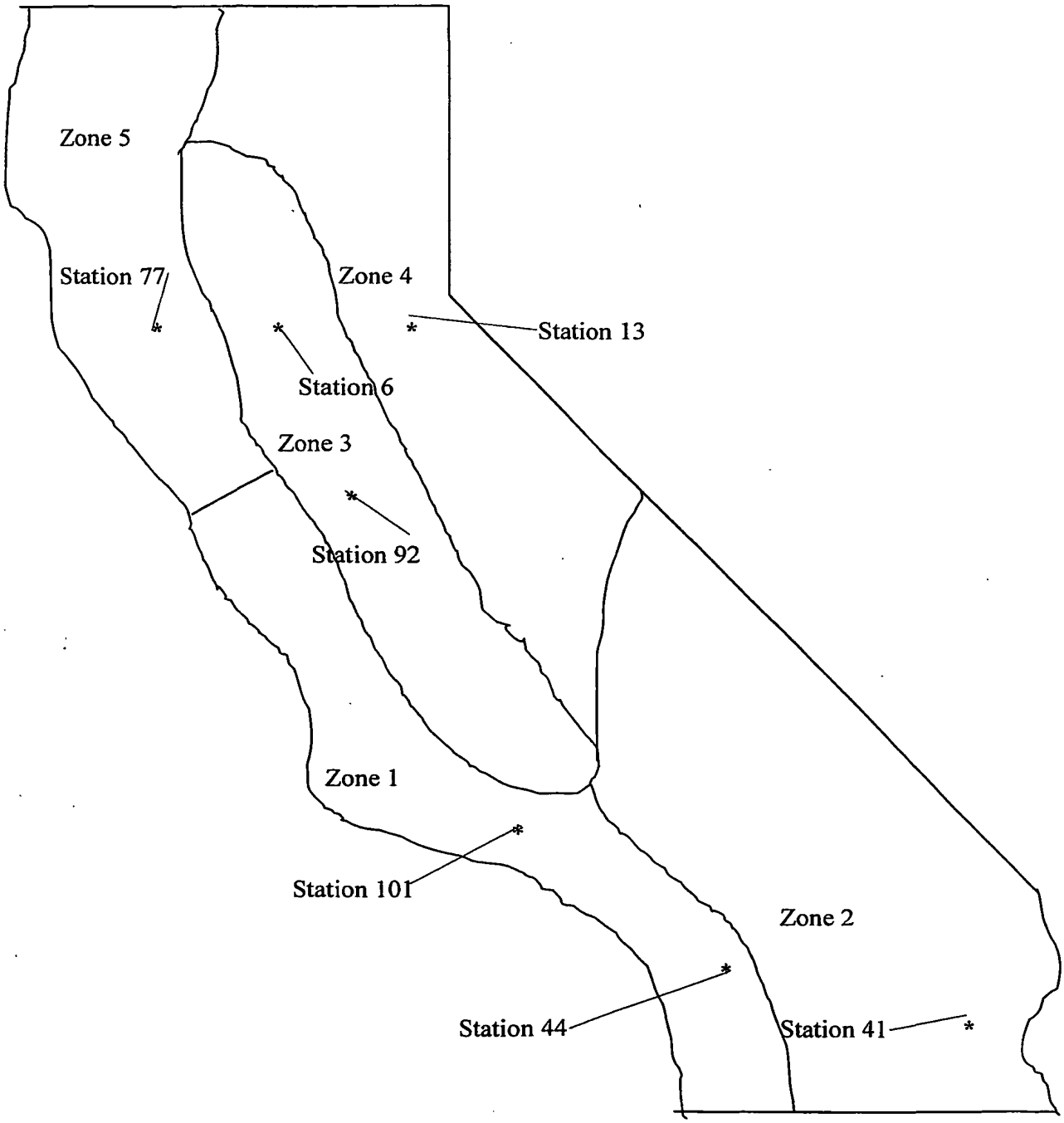

Zone 5
Station 77
Zone 4
Station 13
Station 6
Zone 3
Station 92
Zone 1
Station 101
Zone 2
Station 44
Station 41

Figure 4

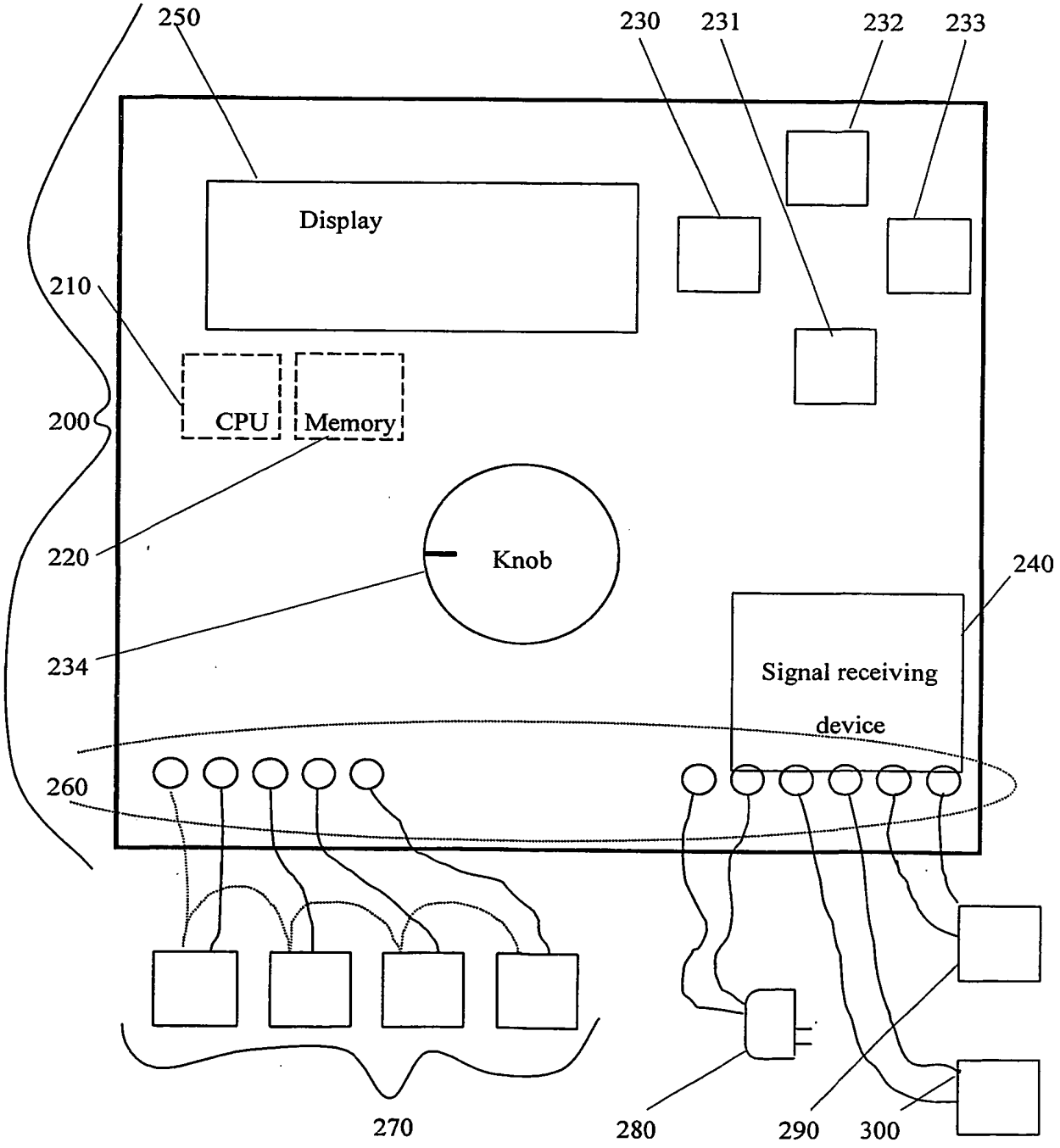

250
230
231
232
233
Display
210
CPU
Memory
200
220
Knob
240
234
Signal receiving
device
260
270
280
290
300

Figure 5

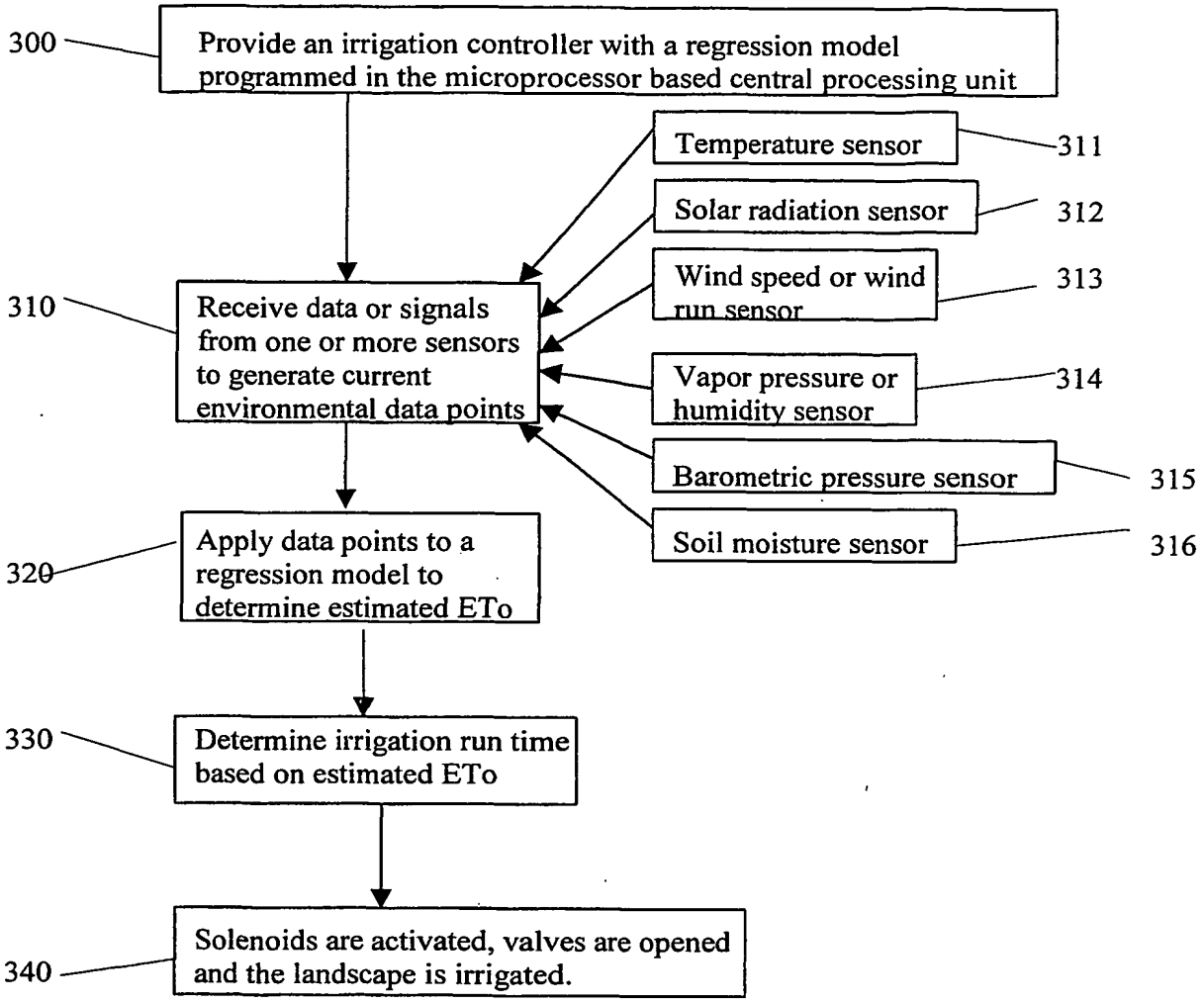

300
Provide an irrigation controller with a regression model programmed in the microprocessor based central processing unit
Temperature sensor
311
Solar radiation sensor
312
Wind speed or wind run sensor
313
310
Receive data or signals from one or more sensors to generate current environmental data points
Vapor pressure or humidity sensor
314
Barometric pressure sensor
315
Soil moisture sensor
316
320
Apply data points to a regression model to determine estimated ETo
330
Determine irrigation run time based on estimated ETo
340
Solenoids are activated, valves are opened and the landscape is irrigated.

Figure 6

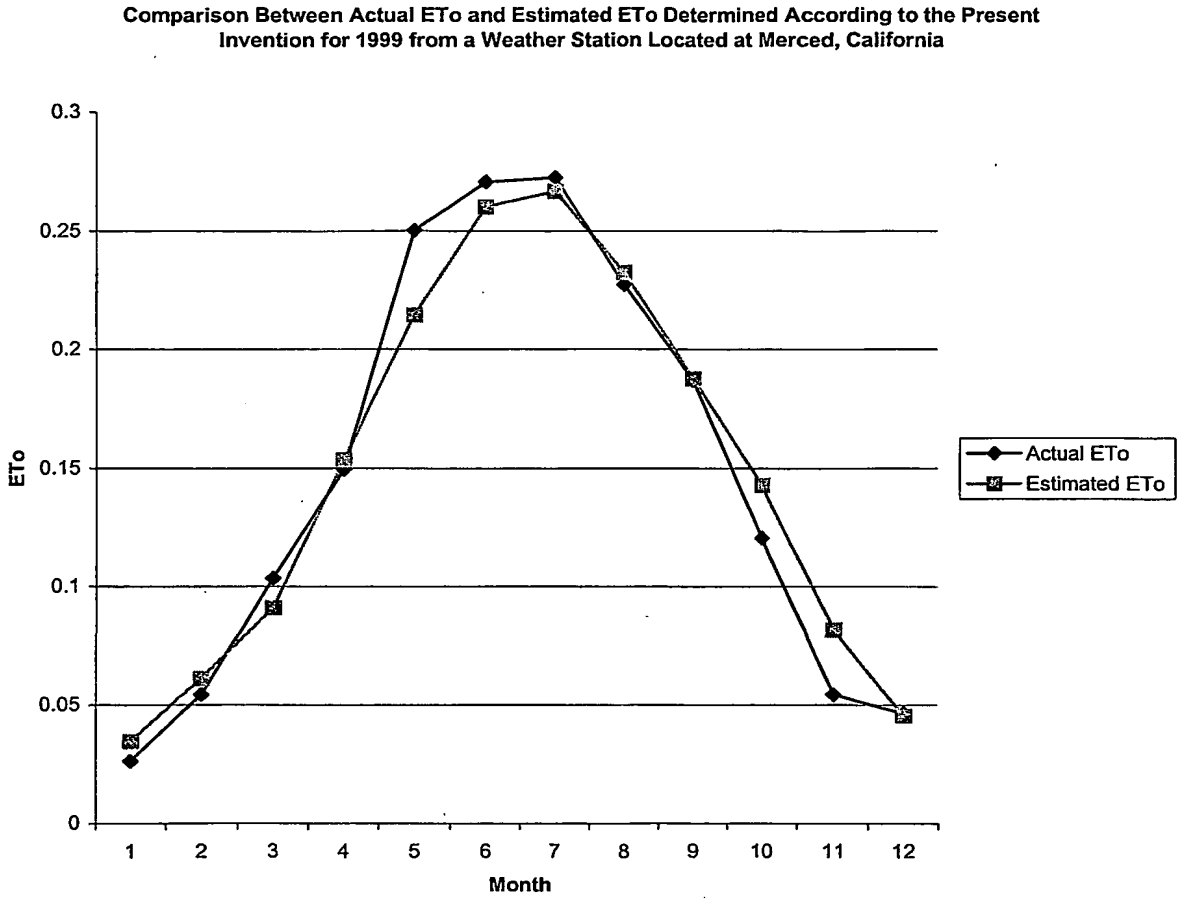

Comparison Between Actual ETo and Estimated ETo Determined According to the Present Invention for 1999 from a Weather Station Located at Merced, California
0.3
0.25
0.2
0.15
0.1
0.05
0
ETo
1
2
3
4
5
6
7
8
9
10
11
12
Month
Actual ETo
Estimated ETo

Figure 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/18705

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G05D 7/06; A01G 25/16
US CL : 700/284; 239/69
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 700/284, 29, 30, 31, 67, 283; 239/69, 63, 64, 67

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,696,671 A (OLIVER) 09 December 1997 (09.12.1997), column 5, lines 7-26; column 5, lines 45-60; column 6, lines 55-67; column 7, lines 24-39; column 7, line 55 - column 8, line 61.	1-15
X	US 5,839,660 A (MORGENSTERN et al) 24 November 1998 (24.11.1998), column 2, line 60 - column 5, line 16.	1-3, 7-10, 12-14
X	US 5,208,855 A (MARIAN) 04 May 1993 (04.05.1993), column 2, lines 20-30; column 3, lines 17-26; column 4, lines 6-10; column 4, lines 28-58.	1, 7-10
A	US 5,097,861 A (HOPKINS et al) 24 March 1992 (24.03.1992), column 3, line 33 - column 6, lines 58; column 7, line 54 - column 8, line 60.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 October 2000 (23.10.2000)	27 DEC 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer William Grant James R. Matthews Telephone No. (703) 305-9600

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/18705

Continuation of B. FIELDS SEARCHED Item 3: EAST BRS

search terms: ((regression adj model) and irrigation), ((regression adj model) and controller), evapotranspiration, ((regression adj model) and sprinkler), ((linear adj regression) and irrigation), (multiple adj regression) and irrigation), (((linear adj regression) and (multiple adj regression)) and irrigation)